IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Teruo Amoh et al.	Conf. No.: 3301
Application No.: 10/599,036	Art Unit: 2894
Filed: September 18, 2006	Examiner: Alexander Belousov
For: SEMICONDUCTOR LIGHT EMITTING ELEMENT MOUNTING MEMBER, AND SEMICONDUCTOR LIGHT EMITTING DEVICE EMPLOYING IT	

APPELLANT'S SUBSTITUTE BRIEF ON APPEAL UNDER 37 C.F.R. § 41.37

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Appellants submit this Brief in accordance with 37 C.F.R. § 41.37 in support of their appeal from the final rejection of claims 1, 3, 4, and 6-13 in the Final Office Action, mailed September 4, 2009.

The original Appeal Brief was filed within one month of the Notice of Panel Decision from Pre-Appeal Brief Review mailed January 11, 2010. The required fee of $540 for submission of this Appeal Brief was submitted therewith. The Commissioner is hereby authorized to charge any unpaid fees deemed required in connection with this Appeal Brief, or to credit any overpayment, to Deposit Account No. 04-0100.

This Substitute Appeal Brief is being filed within a month of a Notification of Non-Compliant Appeal Brief, which issued on March 2, 2010

I. REAL PARTY IN INTEREST

The real party in interest for this appeal is Sumitomo Electric Industries, Ltd. of Osaka, Japan. The inventors assigned their rights to this application to Sumitomo Electric Industries, Ltd. (Reel 018395, Frame 0352).

II. RELATED APPEALS AND INTERFERENCES

To appellants' knowledge, there are no other appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

A. Total Number of Claims in Application

There are 11 claims pending in this application.

B. Current Status of Claims

1. Claims canceled: claims 2 and 5 were previously canceled.

2. Claims withdrawn: None

3. Claims pending: claims 1, 3, 4 and 6-13

4. Claim allowed: None

5. Claims rejected: claims 1, 3, 4 and 6-13

C. Claims on Appeal

The claims on Appeal are claims 1, 3, 4 and 6-13. A copy of the pending claims is provided in the **Claims Appendix**.

IV. STATUS OF AMENDMENTS

No amendments have been filed subsequent to the mailing of the September 18, 2009 Response to Final Office Action. In the October 20, 2009 Advisory Action, the Examiner declined to enter the proposed amendments to the pending claims filed on September 18, 2009.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention is a semiconductor light-emitting element mounting member having enhanced reflectivity and light-emission efficiency. *See* claim 1 (the sole independent claim); abstract. The mounting member includes (i) a substrate, (ii) an adhesion layer having a thickness of 0.01 to 1.00 μm, (iii) a barrier layer having a thickness of 0.01 to 1.50 μm on the adhesion layer, and (iv) a metal film on the barrier layer (Specification[1], ¶12, 13, and 25). The metal film is formed from silver (Ag), aluminum (Al), or an alloy containing both of these metals, and has a thickness of 0.5 to 3 μm (*id.*, ¶16 and 28). The metal film functions as an electrode layer for mounting a semiconductor light-emitting element (*id.*, ¶12). The metal film also functions as a reflective layer for reflecting light from the light-emitting element (*id.*).

The inventors have found that enhanced reflectivity can be achieved by controlling two parameters in the metal layer which reflects the light. Specifically, the metal layer in the present invention (i) has a center-line average roughness Ra of no more than 0.1 microns, and (ii) contains crystals grains of silver, aluminum or an alloy thereof along a surface plane of the metal film, where the grains have a particle diameter of no more than 0.5 microns (*id.*, ¶23 and 65). This is shown by

the data in Tables 1 and 2 of the present application. For instance, when these requirements for the metal film are not met, the reflectivity of the metal film drops significantly below 75%. *See* the results for the first, second, and third comparative examples in Table 1.

Dependent claim 3 specifies that the metal film is formed as an alloy of at least one of silver (Ag) and aluminum (Al), and another metal, where the proportional content of the other metal is 0.001 - 10 percent by weight.(Specification ¶ 14). Claim 4 depends from claim 3 and specifies that the other metal is at least one type of metal selected from Cu, Mg, Si, Mn, Ti, and Cr (Specification ¶ 15).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1) Whether claims 1, 3, 4 and 6-13 can properly be rejected as obvious under 35 U.S.C. § 103(a) over Ishii (Japanese Laid-Open Application No. JP 2002-127948) in view of the Examiner's statement of what was known in the art at the time of invention. (All citations below are to the U.S. counterpart to Ishii, U.S. Patent Publication No. 2005/0167679.)

2) Whether claim 6 can be properly be rejected as obvious under 35 U.S. C. § 103(a) over Ishii in view of Krames (U.S. Patent Publication No. 2002/0171087) and the Examiner's statement of what was known in the art at the time of invention.

VII. ARGUMENT

Grounds of Rejection No. 1: Obviousness rejection of claims 1, 3, 4, and 7-13 based on a combination of Ishii and the Examiner's Statement Of What Was Known in the Art at the Time of Invention

Ishii does not disclose or suggest a silver- or aluminum-containing metal film having a

[1] All cites to the specification are to the published version of the application, US 2007/0215895.

center-line average roughness Ra of no more than 0.1 microns, and containing crystal grains of silver, aluminum or an alloy thereof having a particle diameter of no more than 0.5 microns along a surface plane of the metal film, as required by the pending claims. The metal film of the present invention has enhanced reflectivity and therefore light-emission efficiency.

While acknowledging that Ishii fails to disclose particle diameter or center-line average roughness for a metal film, the Examiner contends that it would have been obvious to modify Ishii to have such crystal grains and roughness in order to prevent formation of gaps between the sub-mount and chip mounted on it. *See* p. 4 of the Final Office Action dated July 23, 2009.

B. Ishii does not disclose or suggest a metal film with an average roughness of no more than 0.1 μm.

Ishii and the present invention include a substrate as a base layer on which one or more metal films may be formed. Ishii describes that the substrate has an average roughness Ra of at most 1 μm (preferably at most 0.1 μm) and a flatness of at most 5 μm (preferably at most 1 μm), but is silent as to any roughness or flatness of metal films. See Ishii, paragraph [0058]. Ishii describes a gold (Au) alloy layer that functions as an electrode, but does not disclose an average roughness for it. The Examiner, however, contends that it would have been obvious to use these specifications of the substrate for the metal films as well, based on the Japanese Industrial Standards mentioned in Ishii. It is respectfully submitted that the Examiner has misinterpreted the Japanese Industrial Standards mentioned in Ishii.

The Japanese Industrial Standards JIS B 0601 and JIS B 0621 merely provide a standard definition for average roughness Ra and flatness, respectively. See Ishii, paragraph [0058]. In other words, the standards do not set forth, for example, a required roughness for a substrate of a semiconductor device as it appears the Examiner has interpreted them, but rather set forth general measurement methods for determining the roughness and flatness of a surface. Specifically, JIS B 0601 standards point out the industry accepted calculations for determining average roughness of a surface (Arithmetic Average roughness Ra vs. Maximum Height Ry vs. Ten-Spot Average

Roughness Rz). JIS B 0621 is directed to Definitions and Notations of geometric deviations using round-form measuring instruments. Thus, contrary to the Examiner's contentions, there is no "default" standard or requirement for surface roughness and flatness which can be substituted for the unspecified roughness and flatness of the metal layer of Ishii. See Final Office Action dated July 23, 2009, Page 4. Likewise, there is no "strict standard on surface roughness and diameter" which can be applied to more layers. See Final Office Action dated July 23, 2009, Pages 4-5.

Further support for the lack of a default standard comes from Ishii itself. Ishii directs the substrate characteristics to the specific task of cooling a laser diode. As such, Ishii teaches that the substrate geometric deviations and average height calculations as directed by the Japanese Industrial Standards have yielded the range in surface roughness and flatness as disclosed in Paragraph [0058]. This is the opposite of the Examiner's contention. There is no standard for the substrate, there is a standard for the calculations to determine the average roughness of the substrate as it applies the particular circumstances of the sub-mount in Ishii.

Lastly, the present application itself makes use of the JIS standards. The specification at [0066] states:

> [0066] The center-line average roughness Ra of the surface of the metal films 11, 12 and the surface of the substrate 10 can be determined by applying "Definition and indication of surface roughness in Japan Industrial Standards JIS B0601 based on the surface shape as measured by conventionally known measurements methods".

It is clear that the JIS provides a definition of surface roughness and not a specific value that is the standard of surface roughness.

Ishii, therefore, fails to describe the surface characteristics of its metal layers.

C. Ishii does not disclose or suggest particle diameter of no more than 0.5 μm for the metal or alloy.

The Examiner contends that paragraph 58 of Ishii specifies the particle diameter of the substrate. See Final Office Action dated July 23, 2009, Page 3. However, as discussed above, Ishii only describes the flatness and average roughness of the substrate. See Ishii, paragraph [0058]. In addition to improperly applying properties of the substrate to the metal layers as mentioned above, it is respectfully submitted that the Examiner has also improperly correlated flatness and/or average roughness to the particle diameter of the metal or alloy in the metal film.

Independent claim 1 recites that the metal film is formed from crystal grains with a particle diameter of no more than 0.5 μm. Generally, smaller particle size and a smoother surface decrease diffuse reflection of light on a metal film. However, flatness and roughness are not necessarily related to particle size since flatness refers to the degree to which an entire surface varies from a horizontal plane and average roughness Ra is taken across an entire surface. Accordingly, a surface may include some crystal grains of a large diameter and still be relatively flat and smooth. Thus, even though the surface may have a low average roughness, the presence of some crystal grains with a large diameter would increase diffuse reflection of light. On the other hand, a surface formed of only small diameter crystal grains could have a high average roughness, for example, if the surface is a rolling surface or has asperities. This high average roughness would also increase diffuse reflection of light. Thus, both a particular particle diameter and average roughness are necessary to achieve decreased diffuse reflectivity and particle diameter cannot be determined from flatness and average roughness which generally describe an entire surface.

Moreover, Ishii does not disclose or suggest any criticality to the center-line average roughness Ra of the metal layer, or the size of crystal grains of silver, aluminum, or an alloy thereof along its surface plane. Additionally, Ishii does not teach that the surface properties of the metal layer should be controlled in any manner. Rather, Ishii teaches a solder layer positioned below the laser diode and attached thereto by melting. See Ishii, paragraph 83. Accordingly, the reflective

metal layer is formed without controlling the particle size of any crystal grains which may form. Ishii also does not disclose or suggest any subsequent modification of its solder layer

D Ishii does not disclose or suggest an Al or Ag alloy as an electrode wherein the proportional content of another metal in the alloy is 0.001 -10 percent by weight.

Dependent claim 3 recites that the metal film is formed as an alloy of at least one of silver (Ag) and aluminum (Al), and another metal, where the proportional content of the other metal is 0.001-10 percent by weight. The Examiner argues that Ishii describes a "mainly" gold (Au) electrode. See July 23, 2009 Final Office Action, pg 3. The Examiner has interpreted "mainly" to mean "mostly", i.e. that Ishii is describing an alloy of gold, with the implicit understanding that the other metal in that alloy are either silver or aluminum. *See* July 23, 2009 Final Office Action, pg 3. Claim 3 clearly states that the metal film alloy must be at least 90% Ag or Al (or a combination of the two) and at most 10% of another metal. Claim 4 recites that the alloy includes Cu, Mg, Si, Mn, Ti or Cr. Claims 3 and 4 do not indicate that gold is included in the alloy. Therefore, Ishii teaches away from express limitations in material usage found in rejected claims 3 and 4.

The Examiner attempts to correct this deficiency by submitting that layers 6 ,7a and 7b in Ishii can be made sufficiently thin so as to be considered an alloy. *See* July 23, 2009 Final Office Action, p. 5. However, the Examiner fails to consider that Ishii only teaches the use of gold (Au) for the electrode layer. As such, any "sufficiently thin" pseudo-alloy created by employing sufficiently thin metal layers and combined with "heating and compression" still yields an alloy that has large amounts of gold. As such, it is clear that Ishii fails to disclose a metal film layer comprising an alloy of containing at least 90% silver, aluminum, or a combination of the two, and at most 10% Cu, Mg, Si, Mn, Ti and Cr. Therefore, claims 3 and 4 are not obvious over Ishii.

Grounds of Rejection No. 2: Obvious rejection of claim 6 based on a combination of Ishii in view of Krames et al and the Examiner's Statement Of What Was Known in the Art at the Time of Invention

Claim 6 has been rejected under 35 U.S.C. §103(a) as obvious over Ishii in view of U.S. Patent Application Publication No. 2002/0171087 by Krames et al. ("Krames"). Since Ishii fails to disclose or suggest a particle size for crystal grains in the metal, it cannot render claim 1 obvious. Krames is likewise silent as to controlling particle diameter of crystal grains in a metal film and therefore does not remedy this deficiency. Therefore, even in view of Krames, none of the claims are obvious over Ishii.

CONCLUSION

For the foregoing reasons, the rejection of claims 1, 3, 4 and 6-13 should be reversed. Appellants respectfully request that the application be remanded to the Primary Examiner with instructions to withdraw the rejection under 35 U.S.C. § 103(a), and pass the case to the allowance.

Dated: March 19, 2010

Respectfully submitted,

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CLAIMS APPENDIX

The following is a copy of the claims involved in the appeal:

1. (Previously presented) A semiconductor light-emitting element mounting member comprising:

a substrate; and

a metal film formed on a surface of said substrate, formed from Ag, Al, or an alloy containing said metals, and functioning as an electrode layer for mounting at least one of a semiconductor light-emitting element and a reflective layer for reflecting light from a semiconductor light-emitting element; wherein:

the thickness of the metal film is 0.5 - 3 μm;

crystal grains of said metal or alloy forming said metal film have a particle diameter along a surface plane of said metal film of no more than 0.5 μm;

said surface of said metal film has a center-line average roughness Ra of no more than 0.1 μm;

an adhesion layer and a barrier layer are formed, in sequence, on said substrate, with said metal film being formed on said barrier layer;

the thickness of the adhesion layer is 0.01-1.00 μm; and

the thickness of the barrier layer is 0.01-1.50 μm.

2. (Canceled)

3. (Previously presented) The semiconductor light-emitting element mounting member according to claim 1 wherein said metal film is formed as an alloy of at least one of Ag and Al and other metal, a proportional content of said other metal being 0.001 - 10 percent by weight.

4. (Previously presented) The semiconductor light-emitting element mounting member

according to claim 3 wherein said other metal is at least one type of metal selected from a group consisting of Cu, Mg, Si, Mn, Ti, and Cr.

5. (Canceled)

6. (Previously presented) The semiconductor light-emitting element mounting member according to claim 1 wherein said metal film is formed from Al alone or from an alloy of Al and other metal.

7. (Previously presented) The semiconductor light-emitting element mounting member according to claim 1 wherein a thermal expansion coefficient of said substrate is 1×10^{-6}/K - 10×10^{-6}/K.

8. (Previously presented) The semiconductor light-emitting element mounting member according to claim 1 wherein a thermal conductivity of said substrate is at least 80 W/mK.

9. (Previously presented) The semiconductor light-emitting element mounting member according to claim 1 wherein said semiconductor light-emitting element mounting member is a flat submount.

10. (Previously presented) A semiconductor light-emitting device, comprising:
the semiconductor light-emitting element mounting member of claim 1; and
a semiconductor light-emitting element mounted in said semiconductor light-emitting element mounting member.

11. (Previously presented) The semiconductor light-emitting device according to claim 10 wherein the output of said semiconductor light-emitting element is at least 1 W.

12. (Previously presented) The semiconductor light-emitting mounting member according to claim 1 wherein said substrate is an insulative ceramic.

13. (Previously presented) The semiconductor light-emitting mounting member according to claim 12 wherein the insulative ceramic is selected from a group consisting of AlN, Al_2O_3, SiC, Si_3N_4, BeO, BN, and insulative Si

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings for this matter.